DEM Calibration Procedure for Bulk Physical Tests: A Case Study Using the Casagrande Shear Box Test

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Abstract

Understanding the behavior of granular materials is critical in a variety of industries ranging for powders in pharmaceuticals to gravel and sand for civil engineering applications. The macroscopic behavior of granular media cannot be described by a rheological model. This direct numerical simulation at the particle scale using the Discrete Element Method (DEM) is required to simulate granular material. The discrete element method models (DEM) takes into account the micro mechanical parameters at particle scale to predict the response at the macroscopic scale. As the response depends on the material under consideration, the calibration of the DEM is required. The applicability and usefulness of a calibrated discrete element model (DEM) is highly dependent on the quality of the calibration process. This calibration process often needs to be repeated between applications and even for the same application at sufficiently distinct parameter subdomains. The current research paper is a scientific exploration of the shear behavior of an idealized model of granular materials (glass beads) using the Casagrande shear box test in order to calibrate the DEM models. Two DEM contact models were calibrated using a systematic calibration process developed in this study. The calibration process relies on design of experiments , radial basis function interpolations and robust optimization strategies [1] to find suitable parameters. The predictability of the two calibrated DEM models are investigated as the experimental parameters such as the normal force are chosen further and further away from the experimental parameters used during calibration. The aim of this study is to check the predictability of the calibrated DEM models which can provide valuable information for additional laboratory results to finally obtain a sufficiently general DEM model.

References

1. J.Snyman. Practical Mathematical Optimization: An Introduction to Basic Optimization Theory and Classical ans New Gradient –Based Algorithms. Springer (2005).